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## THE QUESTION OF THE ZODIAC IN AMERICA

By HERBERT J. SPINDEN

THE zodiac has long held a place in Old World astronomy but it is doubtful whether any conception remotely resembling it ever existed among American Indians. An opinion to the contrary by Humboldt,<sup>1</sup> one of the first scientists to appreciate the remarkable advances in astronomy made by the ancient Mexicans, obtained wide credence and is often quoted.<sup>2</sup> While none of the early authorities of the first order in either Mexico or Peru makes a definite statement that the zodiac or anything like it was known to the Indians before the arrival of the Spaniards there are not lacking secondary authorities<sup>3</sup> who give some support to this idea. A number of modern champions of the zodiac in America have often expressed their views in scientific journals and it seems proper to state the case of the opposition lest they win by default. In the course of argument these writers have repeatedly assumed identity in meaning (and therefore an unavoidable historical connection) between astronomical and hieratic symbols in Mexico and Central America and zodiacal symbols in the Old World, but have failed conspicuously to meet the broader arguments in force against such assumptions.

In this paper the discussion will proceed as follows. First, will be presented a brief explanation of the Old World zodiac and a summary of the general arguments against the assumption that this concept was transferred to the New World before the time of Columbus. This summary is not designed to settle the question upon *a priori* grounds but simply to record the tremendous weight of evidence against the aforesaid assumption of transference. Second, the particular proofs and arguments made by the champions

<sup>1</sup> 1810, p. 149, et seq.

<sup>2</sup> Clerke, 1911.

<sup>3</sup> For instance, Granados.

of the Old World zodiac in America will be examined upon their own merits, in the light of scientific research in Mexico, Central America, Peru, etc. Third, the possibility of an independent invention in the New World of a concept analogous to the classical zodiac will be discussed. This last phase of the subject will take us out of destructive criticism into a field that is practically undeveloped.

The formal zodiac is a band round the celestial sphere, about  $18^{\circ}$  in width, with the ecliptic as a medial line. Within this band lie the apparent paths of the sun, moon, and planets. The zodiac is divided into 12 signs, or divisions, of  $30^{\circ}$  each, covering the passage of the sun from one vernal equinox to the next; and in ancient times these signs were marked by twelve constellations from which they took their names. By reason of precession the constellations of the Greek astronomers no longer mark the signs of the modern zodiac but are  $30^{\circ}$  to the east of them.

The twelve constellations of the classical zodiac are as follows:

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|----------------------|----------------------------|
| 1. Aries, the Ram    | 7. Libra, the Balance      |
| 2. Taurus, the Bull  | 8. Scorpio, the Scorpion   |
| 3. Gemini, the Twins | 9. Sagittarius, the Archer |
| 4. Cancer, the Crab  | 10. Capricornus, the Goat  |
| 5. Leo, the Lion     | 11. Aquarius, the Waterman |
| 6. Virgo, the Virgin | 12. Pisces, the Fishes     |

It is unnecessary to discuss in detail the history and distribution of the various zodiacal conceptions in the Old World. The agricultural and pastoral peoples of western Asia were noted stargazers. Among them the rising of certain constellations in the morning twilight may have been used to indicate the time for important festivals. They observed that the sun, moon, and planets followed a definite path across the sky and they picked out various star groups as markers by which the unequal progress of these luminaries could be measured. While the time periods of the apparent or synodical revolutions of these orbs—taken from one rising or setting with the sun to the next—might likewise be observed, the organization of a zodiac naturally led to the determination of true or sidereal revolutions. The further use of the zodiac in the nefarious art of forecasting events is well known.

The classical zodiac may be called a solar zodiac although in reality its time period is the sidereal revolution of the earth. Each sign may originally have served to mark the advance of the sun among the stars from one new moon to the next. But since twelve moons fall several days short of a year a readjustment was necessary and the signs were lengthened slightly till they closed up the circuit of the heavens. The Greeks obtained their zodiac from the Assyrians and after enriching it with mythological instances they passed it on as a heritage to western Europe.

A lunar zodiac of twenty-seven or twenty-eight mansions served to mark the daily progress of the moon among the stars and the period of this zodiac was therefore the sidereal revolution of the moon. The lunar zodiac seems to have had its greatest vogue in India. The so-called zodiac of the Chinese may be entirely independent and apart from the zodiacs of western Asia.

We can do little more than conjecture the antiquity of the zodiac in Mesopotamia. It is pretty certain, however, that it rose after the invention of agriculture. We cannot be sure that the earliest notices of constellations of the ecliptic indicate that the concept of the zodiac had already been organized. The sign of Taurus appears to have been the earliest one to begin the cycle which would indicate that the zodiac was formulated about 2500 B.C. In its present sequence, with Aries as the first sign, the zodiac dates from the Greek period. Let us now examine some of the general arguments against the theory that the zodiac was introduced from the Old World into the New before the time of Columbus.

It is generally admitted that America was originally populated from Asia, but on a culture horizon no higher than the neolithic. The simple arts of stone chipping and basket-making were probably brought over by the earliest immigrants but there is abundant evidence that pottery-making, weaving, and agriculture were independently invented long after the original settlement. The cultivated food plants are different from those found in the Old World and there is a vast region in northwestern America and northeastern Asia upon the only obvious line of communication where agriculture and the higher arts have seemingly never been known.

Mr. Stansbury Hagar<sup>1</sup> admits that a knowledge of the zodiac could not have come with the first influx of man into America and that it must have come through accidental or sporadic communication at some later time. He also eliminates the possibility of communication from western Europe and apparently rests his case upon the familiar and romantic device of the venturesome Chinese junk or the ubiquitous Phoenician galley. Granting that vessels in ancient times might have been cast up on the shores of America, what likelihood is there that shipwrecked sailors could introduce such a complicated idea as the zodiac? We know that Scandinavian settlements held their own for several hundred years in Greenland and that journeys were made to Labrador for timber, but we find no trustworthy evidence of influence upon the Northern Indians either in objects or ideas.

There are a small number of anthropologists, such as Graebner, who have assumed an historical explanation for the close similarities in ideas, in social and religious structures, and in material art that are found between otherwise distinct peoples in the New and Old Worlds. The weight of evidence indicates that these similarities should be explained by psychic unity and convergent evolution, rather than by contact and transmission. It is generally admitted that human beings are everywhere so similar in mental structure that they are apt to return the same answer to the same problem. Tools and many other objects of material culture are made in response to insistent and universal needs. Materials while not everywhere the same fall into certain general classes. Mechanical possibilities are often so limited that independent invention of practically the same object is often seen in different parts of the world. Sometimes objects or ideas with diverse original forms modify towards similar resultant forms. Archeological and ethnological science finds it unwise to assume actual connection in the past between peoples who in the present are widely sundered unless there is a bond of language or strong proofs that a considerable number of technological and intellectual concepts have a common origin. In almost all cases where real connection has been proven

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<sup>1</sup> 1912c, pp. 47-48.

the phenomenon of divergent evolution is important. This is the very opposite of the convergent evolution which to uninitiates furnishes material for phantastic theories.

The history of American civilizations has been blocked out in the rough. The sequence of culture in Mexico and Central America, in particular, has been carefully studied. The most remarkable features were developed from crude beginnings in a manner that is capable of demonstration. Food plants, especially maize, having been domesticated and agriculture put on a firm basis somewhere in Mexico or Central America, new possibilities for human society arose. The pressure of the population upon the food supply was reduced and this doubtless led to a great increase in numbers and to an added effectiveness in coöperation. We have every reason to believe that agriculture passed from this original center over a large part of North and South America and that with it went certain tools and ceremonies which became more or less modified in dispersal. Now agricultural peoples are sedentary and they are more deeply concerned with seasonal changes and astronomical facts than are ranging hunters. There is pretty clear evidence that rough lunar calendars were originally used by the tribes of Mexico and Central America as they are today by the nomadic Indians of North America. But these crude time counts were perfected and the phenomena of the heavens were duly observed and noted after the Indians had acquired permanent habitations and much leisure. It is well known that the Mayan and Nahuan tribes were able to determine with great exactness the length of the year and to calculate the synodical revolutions of the moon, Venus, and other planets. In Peru the knowledge was less extensive but the solstices and equinoxes were carefully measured and Venus was recognized in her double guise as Evening and Morningstar. We must not forget that the most remarkable features of the Central American time counts are absolutely without parallel in any part of the world. They were based not alone upon astronomical facts but also upon a peculiar system of numbers.

Let us now examine the evidences bearing on the zodiac in America presented in several papers by Mr. Hagar. He professes

to find proof that the zodiacal divisions were known to the Pueblo Indians of the Southwest, to the Mayan, Nahuatl, and Zapotecan tribes of Mexico and Central America, and to the Peruvians. While he constantly uses the classical zodiac for purposes of comparison he constructs for the nations of Mexico and Central America several variations. First, there is a zodiac of ten parts based on pictures in native books and on random information in Spanish historians of the second crop. Second, there is the normal zodiac of twelve parts reflected in mural decorations and in the arrangement of pyramids at Izamal, Teotihuacan, etc. Third, there is the sequence of the eighteen months of the year, and fourth, the sequence of the twenty days of the month. Both of these are warped into agreement with the normal zodiac.

One half of a ten part zodiac Mr. Hagar finds in the constellations given by Tezozomoc<sup>1</sup> where this historian recites the list of duties read to a newly elected king.

"You must take special care to rise at midnight [and study these stars], Yohualitqu Mamalhuaztli, as they call the Keys of St. Peter among the stars of the sky; Citlatlactli, the North and Its Wheel; Tianquiztli, the Pleiades, and Colotl Ixayac, the constellation of the Scorpion. These are markers of the four parts of the world according to the heavens. And towards dawn you must observe carefully the constellation Xonecuilli, the Cross of St. Jacob, which appears in the southern sky."

Seler<sup>2</sup> has reproduced plans of all five star groups from the original manuscript of Sahagun who refers to three of them by name in his published texts.<sup>3</sup> Both Seler and Hagar<sup>4</sup> attempt to match the rather conventional plans of Sahagun into star charts. One of the earliest and at the same time the fullest discussion of these stars is that of Paso y Troncoso.<sup>5</sup> Information and opinion may be summed up as follows.

Mamalhuaztli means the Fire Drill (consisting of a vertical and a

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<sup>1</sup> 1878, p. 574.

<sup>2</sup> Bull. 28, pp. 355-358; additional information, Seler, 1902-1908, I, pp. 618-623.

<sup>3</sup> 1880, p. 482 and Bustamanti Edition, I, p. 346.

<sup>4</sup> 1910, p. 278.

<sup>5</sup> 1882, pp. 388-398.

horizontal stick) and the supplementary terms Yohualitqui (Tezozomoc) and Yoaltecutli (Sahagun) mean, respectively, Night-bringer and Night-lord. Sahagun makes the definite statement that this constellation is near the Pleiades in Taurus. The published text of Tezozomoc gives the Keys of St. Peter (a star in Aries) as an equivalent Spanish term, but Seler suggests that *nave* (ship) was misread *llave* (key) in manuscript. The Ship of St. Peter is formed by seven stars in Taurus with Aldebaran as the principal one. Paso y Troncoso<sup>1</sup> discusses this constellation fully and after stating various opinions agrees with Molina that it lies in Gemini but his arguments, based upon an identification of this constellation with The Wands (*Los Astillejos*) do not seem sufficient to overrule the statement of Sahagun. Orozco y Berra<sup>2</sup> suggests the Belt of Orion for the three stars associated with the advent of night, while Robelo<sup>3</sup> agrees with the majority in placing the constellation Mamalhuaztli in Taurus. Hagar<sup>4</sup> is forced to choose Cancer by the exigencies of his thesis and is able to find a star grouping that agrees fairly well with the plan of Sahagun but that has nothing else to be said in its favor.

Citlatlachtli means the Star Ball Ground although explained by Tezozomoc as the North-and-Its-Wheel. It is constructed by Seler out of circumpolar stars.

Tianquiztli, the Market, is definitely stated by Tezozomoc to be the Pleiades. It was also called Miec, the Heap. This constellation is said to have assumed special importance among the Aztecs in connection with a new-fire ceremony at the beginning of a 52-year cycle. Sahagun's plan agrees with this group (although supernumerary stars are shown as in other cases) and it is quite unnecessary for us to accept the suggestion that the inconspicuous stars of Virgo are represented.

Colotl, the Scorpion, or Colotl Ixayac, the Scorpion Face, is the Aztec name for a constellation possibly identical with Zinaan Ek, the Scorpion Stars of the Maya. Assuming that this constellation marked the cardinal point west for the Mexicans, Seler argues that

<sup>1</sup> 1882, pp. 390, 396-397.

<sup>2</sup> 1880, I, p. 32.

<sup>3</sup> 1905, pp. 238-239.

<sup>4</sup> 1910, p. 286.

it could hardly have been the classical Scorpio which lies far south of the Equator. He then offers the suggestion that stars in Boötes made up this group and that Arcturus instead of Antares was the "heart of the scorpion." If the scorpion star groups of the New and Old World are really the same we have indeed a remarkable coincidence. Still the constellation is a very brilliant one, the curved tail is a conspicuous feature and the Aztec word for scorpion means curved. As far as the statement of Tezozomoc goes, Seler has no support in his assumption that the star group marked west rather than south. In fact he deliberately includes a fifth constellation, not named as a direction marker, for south and then takes the Pleiades from the west to mark the center or zenith. A modern star map of the Huichol<sup>1</sup> represents the Scorpion with the claws opening towards the west but it stretches across the sky and can hardly be said to mark this cardinal point. Indeed, Seler<sup>2</sup> seems to defeat his own arguments by interpreting a symbol at Chichen Itza as referring to the conjunction of the planet Venus with a star group in the form of a scorpion. Such a group must lie close to the ecliptic and there is a possibility that it might be the classical constellation of Scorpio.<sup>3</sup> This matter will be taken up again. Mrs. Nuttall<sup>4</sup> identifies Colotl with Ursa Major.

Xonecuilli has been variously identified as the Southern Cross and Ursa Minor. The name means Twisted Foot and refers to its s-like shape. The constellation may have been connected with the god Mixcoatl.

Taking the Aztec star groups, already described, in the order given by Tezozomoc in the passage quoted above Mr. Hagar identifies them with the following classical signs:

- |                  |                   |
|------------------|-------------------|
| 1. Mamalhuaztli  | Cancer            |
| 2. Citlatlachli  | Leo               |
| 3. Tianquitzli   | Virgo             |
| 4. Colotl Ixayac | Scorpio and Libra |
| 5. Xonecuilli    | Sagittarius       |

<sup>1</sup> Lumholtz, 1900, p. 57.

<sup>2</sup> Seler, 1910, pp. 162-165.

<sup>3</sup> Paso y Troncoso, 1882, p. 388.

<sup>4</sup> Nuttall, 1901, pp. 8-9.

It is apparent that he has seized upon Scorpio (represented by name in both lists) as a point of departure and has counted forward and backward from this constellation along the classical zodiac. The statement made by Tezozomoc himself that the first four of these star groups marked the four directions is a pretty sure indication that they did not form a continuous series along the ecliptic. Besides, we have the word of Sahagun that Mamalhuaztli is in Taurus, rather than in Cancer, and we know that Tianquiztli (the Pleiades) is in the same sign.

Only the second half of the zodiac of ten parts, made possible by joining Scorpio with Libra and Aries with Taurus, is seen by Hagar in the star groups given above. He finds, however, a complete zodiac of this type pictured forth in pages 46-50 of the Dresden Codex. On each page are three pictures. The upper picture represents a god seated on a celestial throne and holding a bowl. The middle picture shows a divinity with spears in one hand and a spear thrower in the other. The bottom picture shows an individual into which a spear has been thrust. In one case this is a jaguar, in another it is God E, and in a third it is God K. Interpretation of these pictures is difficult but Hagar sees in the two lower figures on each page a dominant zodiacal sign and its conquered opposite.

Although the pictures are ambiguous the calculations are unmistakable. Each of these five pages deals with 584 days and together they deal with five times 584 or 2920 days and with thirteen times 2920 or 37960 days. This number 2920 equals eight solar years as well as five synodical revolutions of Venus. Now if the pictures represented a zodiac we should expect to find the sidereal revolutions of Venus dealt with rather than the synodical. Although this number of days almost exactly equals thirteen sidereal revolutions of the planet there is not the slightest evidence that the authors of the codex were aware of the fact. According to Seler, the pictures already referred to have very close analogues in a number of Mexican manuscripts including the Codex Borgia, the Codex Vaticanus B, and the Codex Bologna. They represent the fatal influences of Venus for each one of its five revolutions. In the *Anales de Quauhtitlan* the influences are recorded as follows:

1. In the sign Cipactli it shoots the old men and women.
2. In the sign Coatl it shoots the rain; it will not rain.
3. In the sign Atl there is universal drought.
4. In the sign Acatl it shoots the kings.
5. In the sign Olin, it shoots the youths and maidens.

These five signs are the names of the days with which the 584-day periods begin. In the Dresden Codex they are Cib, Ahau, Kan, Lamat, and Eb. The numbers associated with each sign may vary from 1 to 13 through the entire Venus calendar round of 65 revolutions or 104 years.

The correlation between the zodiacal constellations and the day and month names current among the Mexican and Central American tribes, which Hagar has presented in a number of papers, is a monument to ingenuity. It is well known that the series of named days agrees in meaning in the different languages of this area while the tonalamatl (or permutation cycle of twenty names and thirteen numbers) everywhere begins with equivalent days. (Imix for the Maya, Cipactli for the Nahua, Chijilla for the Zapotec, etc.) But as regards the months there is no such agreement. The names in the different languages are entirely unrelated in meaning and while there may be a common point of departure in time this has not yet been determined.

On the Aztec Calendar Stone the twenty days are represented on one of the outer bands that decorate the disk of the sun. But this circumstance alone gives little support to Mr. Hagar's statement that the circle also represents a zodiac. He assumes that the four great rays represent the solstice and equinoxes and even ventures to point out which one marks the vernal equinox. Here he makes his beginning with the day Acatl and distributes unequally the twenty days to the twelve signs in sequence, with one, two, or three days falling to each sign. Since the concordance of Mexican and Maya days is perfectly known he has no difficulty in extending his correlation to the Maya calendar.

The Mexican days are mostly named from everyday animals and objects. It is possible that some of these names were also given to special stars or to constellations although Mr. Hagar has furnished

no real evidence on this question. In the Bodleian Manuscript, which seems to deal largely with astronomy, there are a number of figures of great stars with identifying glyphs attached. A Flower Star is drawn several times and an Eagle Star is also given. In one picture is shown an Ocelotl head with three star symbols (round eyes) attached: this may represent a constellation. These star signs are mostly used as the names of persons, but possibly we may be justified in supposing that they represent named stars since the observation of stars through notches and forked sticks is pretty clearly shown in this codex. However, simply because three names of Mexican days are also given to stars we must not jump to the conclusion that the other seventeen names exhibit a similar usage. The Cloud or Smoke Star, the Butterfly Star, etc., in the same manuscript do not belong to the day name series.

Another writer, Mr. Hermann Beyer, constructs a zodiac for the Mexicans, namely one of thirteen parts, in which the days are distributed in a fundamentally different fashion. He argues that the two "plumed serpents" that surround the disk of the sun on the Calendar Stone represent the ecliptic. These monsters have been named Xuihcoatl and it seems likely that they are related to the Two-headed Dragon of the Maya (which does not always have two heads). It is true that this earlier concept often bears symbols of astronomical import from its elongated body but these symbols do not occur in a definite sequence as they would have to do if a zodiac were represented. Out of the stars of Taurus Mr. Beyer constructs the head of Xuihcoatl. He then identifies this head with Cipactli, the first of the Mexican day series. Now it is pretty certain that Cipactli and its Maya equivalent Imix do refer to some monster but that they refer to Xuihcoatl is pure guesswork. Given a starting point, Mr. Beyer names the thirteen zodiacal divisions as follows:—

1. Cipactli, 2. Ocelotl, 3. Mazatl, 4. Xochitl, 5. Acatl, 6. Mizquintli, 7. Quauhuatl, 8. Malinalli, 9. Coatl, 10. Tecpatl, 11. Cuetzpalin, 12. Ollin, 13. Itzcuintli.

These days are the beginning days of the first fourteen divisions

of the formal tonalamatl except that often the tenth sign (Tecpatl) the day Ozomatli is taken out to represent the polar sky. The series of days given above covers in the tonalamatl a period of fourteen times thirteen or 182 days—or one half of a 364-day year. As we shall see presently the so-called ritualistic year of 364 days is divided a number of ways, among others into thirteen times twenty-eight and twenty-eight times thirteen. Whatever might be said in favor of these divisions being reflected in astronomical symbolism cannot be construed as an argument that thirteen divisions of the ecliptic were named in accordance with the list of days given above. If the list covers, let us say, the first half of a year it will not occupy the same position again for thirteen years and in the meantime will continually occupy a variety of other positions separated by intervals of seventy-eight days (the rest of the tonalamatl after 182 days have been counted out). Such a series of names would be completely out of harmony with star groups along the ecliptic which make their revolution in a sidereal year.

In the curious book called *Tardes Americanos*<sup>1</sup> published in 1778, and written in the form of a dialogue between an Indian and a Spaniard, there is what purports to be a native zodiac. On analysis, however, it turns out to be a distorted tonalamatl. There are said to be twenty signs for the sun's annual course, for each sign thirteen houses and for each house seven characters. The twenty signs are the twenty days of the month in their usual order. The thirteen houses are the first thirteen days of the month and the seven characters are the remaining seven days of the month. Of course, no such arrangement can be made to cover a year.

Humboldt, on the rather slender basis of the evidence available in his day, contributed to the misconception of a Mexican zodiac in which day names played a part. His method of procedure was different from any of those just explained. He simply pointed out that a number of Mexican day names had the same, or approximately the same, meanings as zodiacal names from Tibet,<sup>2</sup> India, and other parts of the Old World. But Humboldt did not pretend

<sup>1</sup> Granados, 1778, pp. 63-67.

<sup>2</sup> Op. cit., p. 157 et seq.

that these similar names were found in the same order, nor did he prove that they were given to a zodiac in Mexico although inferring that they were. Several writers, then, have attempted to use Mexican day signs in the construction of a zodiac, but the entire lack of agreement among them is a strong argument against any one of them being right.

The eighteen months of the year are distributed by Hagar over the twelve signs of the zodiac in a fashion that is somewhat irregular. A naïve effort seems to have been made to find the Aztec and the Maya month in which the vernal equinox fell during the first half of the sixteenth century and to use this as a point of departure by identifying it with Aries. At this time the constellation of Aries was already warped about  $25^{\circ}$  out of its theoretical position by the precession of the equinoxes. Unfortunately Mr. Hagar does not seem to have grasped the exact character of Mexican and Central American time counts because his correlation is considerably awry. Let us examine the table of correspondences for the first three signs.

Sign of classical zodiac	Aztec month	Maya month
Aries	Atlacualco	
	Tlacaxipeualiztli	Mac
Taurus	Tozoztontli	Kankin
	Ueitocoztli	Muan
Gemini	Toxcatl	Pax

Atlacualco is given by several writers as the first month of the Mexican year and its beginning is ordinarily placed in February. But accounts differ pretty widely both as regards Atlacualco being the first month and the day on which it began. If we accept the statement that the year bearer was the initial day of the year (and there seems to be little doubt on this point) it follows from the few exact dates that have come down to us that Toxcatl was the first month.<sup>1</sup> At any rate we have reason to believe that Atlacualco fell on the 6th of February, Old Style, in 1521, or on February 16th of our present calendar. It can be clearly demonstrated that the leap year error was not interpolated in Mexican or Central American year counts, although calculated very accurately, and that

<sup>1</sup> Compare Seler in Bull. 28, pp. 135-143.

the months thus fell behind the seasons at the rate of about twenty-four days to a century. The differences among the various authorities on the beginning days of Mexican months is largely to be explained by this retrogression as well as by the changes instituted in the European calendar by Pope Gregory in 1582.

Tlacaxipeualiztli, the second Mexican month according to some authorities and the first according to others, began in 1521 on March 8th of our present calendar. It took its name from Xipe, the Lord of the Flayed. The cult of this divinity spread from Central Mexico to Salvador and among the Quiché and the Cakchiquel; one of the months was named after this god. In a Cakchiquel calendar dated 1681 the month Tacaxepual is given as the first month of the year and its beginning is placed on January 31st. Counting forward the number of days lost through the failure to correct the leap year error brings us within a day or two of the beginning day of Tlacaxipeualiztli in Mexico in 1521. In the commentary that accompanies this calendar is the statement:

"Because since neither the Mexicans nor these [the Guatemalans] understood leap year day . . . they drew apart and became different from our calendar, and as neither these nor the Mexicans always commenced their year on the first of our February but each four years they lost a day: that is the year 1681, that of '82, that of '83 and that of '84 commences the year of the Indians of this kingdom on the first of February and that of 1685 will commence on the 31st of January and that of 1805 will commence of the first of January and four years thence on the 31st of December, etc."

We have here a clear explanation of the retrogression of the Mexican and Central American calendar. It has long been recognized that interpolated corrections would vitiate the elaborate calculations of the Maya where solar, lunar, and Venus periods are correlated over vast stretches of time. The significance of this indisputable fact in relation to the theory of the zodiac is this. The months could not possibly maintain a close time relation to the signs of the zodiac as Mr. Hagar assumes they did maintain. Even if we should admit that Atlacualco and Tlacaxipeualiztli coincided with the vernal equinox or with the constellation of Aries during the

first years of the Spanish conquest this correlation would not hold for the future and what is more important could not have been true in the past. These two months in 1521 embraced the period between February 16 and March 27 N.S. and barely included the vernal equinox. The sun, however, did not actually enter the constellation of Aries until April was well under way.

Corresponding to these two months he selects only the month Mac from the Maya calendar. Now if we add to the date given by Landa the necessary 10 days to bring it into New Style (Landa died in 1579 and his *Relacion* was written before 1566) we find that the month Mac extended from March 13 to April 1, N.S. To bring this date into conformity with the year 1521 we should put these limits ahead some eight or ten days, thus making up for the loss through leap year interpolations in the European calendar between 1521 and the year when Landa wrote his book.<sup>1</sup> The single Maya month which is given as the zodiacal equivalent of two Mexican months falls entirely out of the range of these two months. Now it is perfectly clear that Mr. Hagar believed he was safe in taking Mac as the month in which the vernal equinox fell. Förstemann had written a number of papers on the supposed positions of the solstices and equinoxes in the Maya months. In these papers there is no doubt that the eminent Americanist proceeded from a false assumption to a false conclusion. This unlooked for failure of the months to occupy fixed positions in the year furnishes an acid test for all the petty details and circumstances which Mr. Hagar has advanced as supplementary proof of his theory.

The figure of the Scorpion, whenever found, serves Mr. Hagar as an infallible indicator of the zodiacal sign of Scorpio. A recent paper by him is devoted principally to this sign in relation to the Maya month Tzec and the day Manik. Arguing from the correlation of the Maya months with the European calendar as given by Landa he is able to make the month Tzec correspond in time with the entrance of the sun into the sign of Scorpio. The month name Tzec is given the meaning scorpion on very doubtful grounds. It is represented

<sup>1</sup> If 1541 had the year bearer 13 Kan as Nakum Pech states then the sample year of Landa with the year bearer 13 Kan must have been 1553. The correlation for 1521 would necessitate the addition of eight days.

by a uniform hieroglyph on the monuments and in the codices over a long period. Moreover the retrogression of the months at the rate of about twenty-four days in a century would soon warp it out of all time relation with its original position in the year.

The glyph *Manik* is also practically identical in ancient and modern forms, and everywhere represents a partially closed hand. It seems to be phonetically connected with the Maya word "to grasp." The day signs in the Books of Chilán Balam are practically worthless since in only a few instances do they agree with the forms preserved by Landa, while these in almost all cases can be definitely connected with the glyphs in the ancient inscriptions. Mr. Hagar finds two anomalous glyphs called *Manik* in these late manuscripts and sees in them a picture of the "conventionalized tail and sting of the scorpion." These glyphs are figured by Mr. Hagar<sup>1</sup> and the writer for one fails to find grounds for such identification.

On pages 38 to 49 of the *Tro Cortesianus* codex are a series of pictures and *tonalamatls* dealing with the chase. In the last half of this section are eighteen pictures of game caught in snares and traps. In sixteen cases the game is a snared deer, in one case it is an armadillo caught in a deadfall trap and in one case it is a snared peccary. The rope which makes the snare is fastened in fourteen instances to a tree or post and in three instances to the tail of a figure that doubtless represents the scorpion. The exact significance of this picture is unknown but the series as a whole has to do with hunter's luck and the black God *M* who seems to be a god of hunting often has a scorpion's tail attached to his belt as a symbol. The scorpion's tail in these pictures ends in a hand. Mr. Hagar identifies these pictures with the zodiacal sign of *Scorpio* and the month *Tzec* and the hand with *Manik*. The snared deer is the opposite sign of the zodiac. Surely such an identification must be called the wildest of guesses.

As concerns the grouping of mounds at Izamal and San Juan Teotihuacan in accordance with the zodiac the opinion of Mr. Hagar in neither case is based upon a study of the archeological remains. For Teotihuacan he depends upon two maps, probably apocryphal,

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<sup>1</sup>1915, p. 489.

both of which come far from giving a faithful plan of the city. As for Izamal the curious account of Lizana does not justify the conclusions drawn from it nor does the rough survey of the remains of this site made after the theory was formulated compare with the hypothetical plan. It would take us too far to criticize in detail Mr. Hagar's paper on Acanceh but his general conclusions have the same inherent errors hitherto observed.

Mr. Hagar also writes on the zodiac among the Peruvians. He sees twelve signs pictured forth in a crude seventeenth century manuscript. Most of the pictures, accompanied by notes in Spanish, Quechua, and Aymara, undoubtedly relate to the heavens. The sun, moon, morning star, evening star, rainbow, etc., are clear enough. Some of the remaining figures may relate to constellations but internal evidence that they relate to a series of zodiacal constellations is conspicuously absent. Mr. Hagar identifies four of the signs after round-about arguments, and then practically assumes that eight others fill out the zodiac. Let us examine the proof of the four in question.

1. The inscription in Quechua reads "Puma lance." Support for identifying it with the sign of Leo is found in priestly writings but all we know for a certainty is that somewhere in the heavens there was a Puma star.

2. The cloud-like figure bears the inscription "Winter cloud" in Spanish and "harvest" in Quechua. Mr. Hagar identifies this with the Pleiades and by extension with Taurus. He admits that the Pleiades was called "the granary" by the Peruvians, but thinks the crude sketch is doubly symbolic of a cloud and an ear of corn!

3. The larger enclosure bears the label "Mother ocean" in Quechua while the smaller one is named "spring." Then there is another word which is translated "umbillicus." And after this the road is clear through Assyrian symbolism to the sign of Aquarius.

4. The sketch bears the Spanish inscription "tree" and an Aymara word which also means tree. But this second word has other meanings such as "king," "mummy" and "immortal." The constellation of Scorpio, associated with festivals of the dead the world over, is here pictured forth as a tree although it would be possible to construct a mummy out of some of its stars!

Where the clearest proofs are as tenuous as in this instance, the admittedly speculative parts are quite beyond discussion. Needless to say other zodiacs constructed for Peru vary from this as far as fancy can range.<sup>1</sup>

How anyone writing on Peruvian astronomy can deliberately ignore Garcilasso de la Vega, who with all his faults, must be considered our best authority on the civilization of the Inca, is inexplicable. By this writer the range of Peruvian astronomical knowledge is thus summed up: "They knew not what caused the increase and wane of the moon, nor the movements of the planets; nor did they take account of more than three planets, and those owing to their size, splendour and beauty. They did not know of the other four planets. They had no ideas of the signs of the zodiac, much less of their influences. They called the sun Yuti, the moon Quilla and the planet Venus Chasca, which means curly from its numerous bright rays. They also observed the seven little goats (Pleiades) from being so close together, and from the difference they saw between them and the other stars, which excited their wonder. They did not watch the other stars, because having no necessity for so doing they knew of no object to be gained by examining them nor had they more special names for the stars than the two already given."<sup>2</sup>

Of course it was not strictly true that the Peruvians had names for none of the remaining stars. But the list is not very long and zodiacal constellations are not conspicuously represented.<sup>3</sup>

In all his papers Mr. Hagar has not presented a single sound and convincing argument, in the opinion of the present writer, that the classical zodiac was introduced from the Old World into America. That a considerable interest was aroused in the zodiac after the Conquest there can be little doubt. A large part of the Book of Chilán Balam of Kaua is an almanac set over rather clumsily into Maya. The Ptolemaic conception of the universe is presented in diagram with the eleven heavens bearing their Latin names. The year of fixed and movable feasts is given in full as well as a

<sup>1</sup> Lopez, 1868, pp. 322-343; Krum-Heller, 1912, etc.

<sup>2</sup> 1869-71, pp. 175-176.

<sup>3</sup> See, for instance, Acosta, 1590, pp. 209-210.

zodiac with pictures of the various signs. The translations of the European names are naïve. Thus Gemini is *catul polal*, "two sons"; Pisces is *cacot cay*, "two fish"; Taurus is *vacax lae*, "a cow it is"—the word *vacax* coming from the Spanish *vaca*. Surely if the Maya had known a zodiac with comparable divisions they would have disclosed the fact in this manuscript.

Zodiacs have been imagined for other American Indian tribes. L'Heureaux<sup>1</sup> claims that the Blackfoot have such a belt of constellations, apparently derived from the Aztecs. A recent German writer<sup>2</sup> establishes the record for absurdity by constructing zodiacs out of the clan names of the Zuñi, Sia, Iroquois, etc.

There is, however, an entirely different problem connected with the zodiac touched on hardly at all by the writers mentioned above. Since the ecliptic is real and permanent and since the stars that lie close to it can be used to mark the progress of the planets without being grouped as in the Old World it is not impossible that a conception akin to the zodiac should have arisen independently in the New World and especially in the region where careful observations of the planets are known to have been made. We know that the sidereal revolutions of the heavenly bodies were well known to the Assyrians and that this knowledge is directly traceable to the formalization of the zodiac concept. Dependable proof of the existence of any sort of zodiac in the New World is to be found not in the far-fetched interpretation of symbolic acts and designs which stand service to the preconceived notions of this or that writer, but in calculations that reflect a knowledge of sidereal time periods and in picture series combined with such calculations.

The natural cycle of the zodiac is the sidereal year. The difference of only twenty minutes between the tropical and sidereal year—mostly accounted for by the precession of the equinoxes—would probably not be observed by nations on a moderate plane of culture. But in the long run this slight difference of a day in seventy years would make itself felt.

There is considerable evidence that the rising of prominent stars

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<sup>1</sup> 1868.

<sup>2</sup> Bork, 1913, pp. 41-46.

and constellations in the morning or evening twilight was duly noted by certain American Indian tribes and that the civil or ceremonial calendar was regulated to some extent by those occurrences. Most tribes were doubtless as well aware of the annual changes in the heavens as they were of the diurnal ones. Star lore among the Hopi, the Pawnee, etc., seems to have gone much farther than is generally supposed, possibly through dissemination of the astronomical knowledge of the Mexicans.

While in the case of the earth itself the difference between the sidereal or true revolution and the tropical or seasonal one is so slight as to be almost negligible this is not the case with the sidereal and synodical revolutions in general. The synodical or apparent revolution of a planet is really not a revolution at all, it is simply the time necessary for the earth to gain or lose a lap in an unequal race round the sun. In the case of the moon the difference is likewise considerable although explainable upon other grounds.

<i>Planet</i>	<i>Sidereal Revolution</i>	<i>Synodical Revolution</i>
Earth	365.26 days	365.24
Moon	27.32	29.53
Mercury	87.97	115.88
Venus	224.70	583.92
Mars	686.95	779.94
Jupiter	4332.58	398.87
Saturn	10759.22	377.75

The sidereal revolution of the moon takes between twenty-seven and twenty-eight days. The European week of seven days came from the east and it has been explained as a quarter of the lunar period as measured by the lunar zodiac. A period of twenty-eight days divided into four weeks of seven days seems to have been known to Central American nations. If such a twenty-eight day month is taken thirteen times we have a 364-day year. In the Dresden and Peresianus codices are calculations dealing with such a year (called by Förstemann the Ritualistic Year) and several vague references to it are found in early writings. Padre Marquez says of the Mexicans: "They divided, in the second place, their year into 28 other periods of 13 days each, or 364 days, leaving one to the end which was considered the most unlucky of the five

nemontemi." But in reality thirteen sidereal lunar months equal only 355.16 days. This sum falls more than ten days short of the true year. It is difficult to see how so poor an approximation as this can offer proof that the progress of the moon among the stars was duly noted. It is much more likely that the 364-day year was chosen for mathematical reasons: this number contains a different set of factors than does 365.

The ritualistic year was divided in a number of ways. First the important tonalamatl period (260 days) is supposed to have been taken out leaving a remainder of 104 days. According to one hypothesis the principal tonalamatl was the one occupying the middle position in this year with 52 days before and after, one quarter of the ritualistic year or 91 days was assigned to each of the Bacab gods who controlled the four directions. The ritualistic year was also divided into thirteen times twenty-eight days, twenty-eight times thirteen days and fifty-two times seven days.

On page 32a of the Dresden Codex is a condensed time count taking the following form:

13	13	13	13
Manik	Cib	Chicchan	Ix
Chuen	Ahau	Muluc	Eznab
Men	Kan	Ben	Ik
Cauac	Lamat	Caban	Cimi
Akbal	Eb	Imix	Oc

Each row of day signs bears the number 13 and if we begin with 13 Ix in the upper right-hand corner and proceed towards the left to 13 Chicchan we find that 91 days have elapsed. The same interval exists between 13 Chicchan and 13 Cib, 13 Cib and 13 Manik; 13 Manik, and 13 Eznab, etc. In other words each horizontal row accounts for four times 91 or 364 days and the five rows account for five times 364 or 1820 days. This equals seven times 260 days and as a result forms a continuous wheel: that is, the last date, 13 Akbal, is exactly 91 days from the first day 13 Ix. Curiously enough the presentations of the Ritualistic Year in the codices have in most cases to be read backwards.

Förstemann attempted to analyze the long numbers that accompany this block of glyphs but was successful only in showing a remarkable series of common multiples. It is evident, however, that the 364-day year was carried along in calculations over great stretches of time. In the inscriptions the numbers 5-1-0 (five times 364) occurs frequently.



FIG. 1. Plate XXIII, Codex Peresianus.

The most important passage in the codices for its possible bearing on a zodiac will now be treated in some detail. On the last two pages of the Peresianus Codex (Plates 23 and 24 of De Rosny's reproduction) are two rows of animal figures in connection with celestial shields and sun symbols. In the upper row the celestial shields are suspended from a constellation band that passes across both pages. In spite of a partial scaling away of the painted surface we may be sure that the constellation band turned downward at the

left and although it might have been cut off short at the right end, there is little doubt that the constellation band formed the elongated body of a Two-headed Dragon. This subject may have been represented with both heads as on Plate 22 of this manuscript or with only the front head as on Plate 76 of the Dresden Codex. The calculations on these two pages can be made complete, as we shall

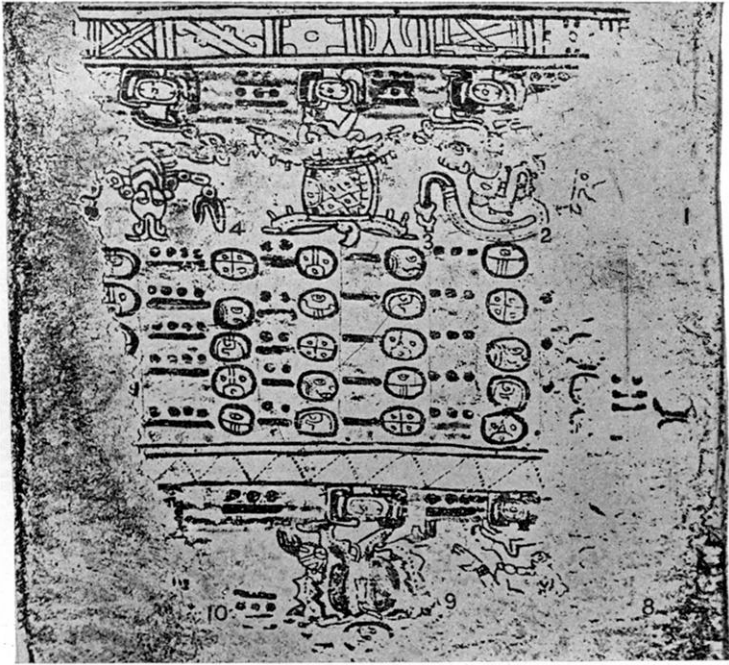


FIG. 2. Plate XXIV, Codex Peresianus.

see, and there is little likelihood that the design was continued on succeeding pages now lost. There are seven animal pictures in the upper row, three on Plate 23, and four on Plate 24. The figure on the extreme right is almost destroyed. The celestial shields of the lower row are attached to a horizontal strip with no other markings than a zigzag dotted line. The figures here are much destroyed but it seems likely that three were originally drawn on each page. Counting the two rows we should thus have thirteen animal figures, each one connected with a symbol of the sun (Figs. 1-2).

Between the two picture series just described are columns of day signs with numbers. They are arranged systematically in columns and rows. The series becomes continuous as Seler and Förstmann have shown, only if we count horizontally from right to left. We then find that each of the five rows has thirteen numbers. The numbers increase by two toward the left. Only five days are represented, namely, *Lamat*, *Cib*, *Kan*, *Eb*, and *Ahau* and in the five rows the permutation of these days with the thirteen numbers is exhausted. If we begin with 12 *Lamat* in the upper right-hand corner and proceed horizontally across the two pages we find a continuous difference of twenty-eight days between adjacent members.

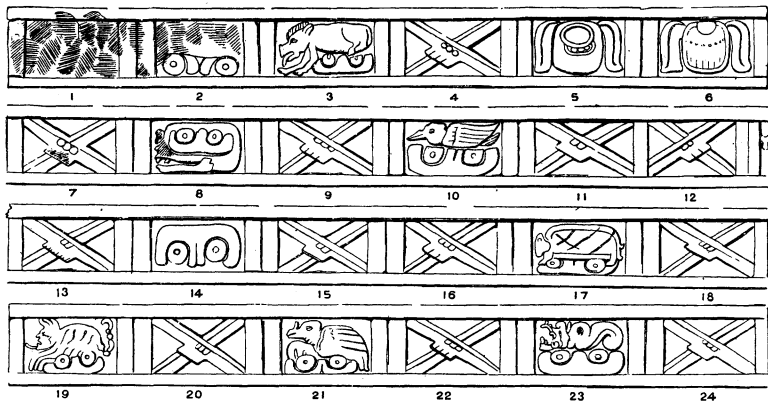


FIG. 3. Star symbols over the doorway in the east wing of the Casa de Monjas, Chichen Itza.

Thus 1 *Cib* is twenty-eight days in advance of 12 *Lamat* while 3 *Kan* is another twenty-eight days in advance of 1 *Cib*. Each row then represents thirteen times twenty-eight or 364 days and the five rows equal five times 364 days or 1820 days. This sum as we have already seen is equal to seven times 260 days and as a result the first day sign of the sixth row—if one should be added—would again be 12 *Lamat*. There are other numbers appearing on these pages which serve some unknown purpose. Thus between each celestial shield there are one or two 8's, and at various points above and below the day sign series there are numerals in blue which may be corrections.

The essential point is that we have here five of the so-called Ritualistic Years, consisting of 364 days and divided into thirteen periods of twenty-eight days each. Now the twenty-eight day period is closer to the sidereal than to the synodical revolution of the moon and it is conceivable that it might have served as the basis for a zodiac. The thirteen animals holding in their mouths the sign of the sun might therefore represent thirteen signs of a zodiac. The pictures are probably to be taken in the same order as the calculations or from right to left. They are as follows:

<i>Upper Line</i>	<i>Lower Line</i>
1 destroyed	8 frog?
2 rattlesnake	9 deer?
3 tortoise	10 destroyed
4 scorpion	11 destroyed
5 king vulture	12 death
6 marine monster	13 peccary
7 bird	

On the eastern façade of the Monjas at Chichen Itza is a long band of star symbols of exceptional interest (Fig. 3). Out of the twenty-four symbols reproduced in Maudslay's drawings no less than twelve are the diagonal cross which from its frequent occurrence elsewhere must be explained as a symbol of broad meaning. Most of the others show the well known Venus hieroglyph in combination with some animal or bird. Seler has suggested that these combinations refer to the conjunction of Venus with various star groups. Since Venus is seen only among the stars of the ecliptic it follows that these star groups may belong to a zodiac. Accepting Maudslay's drawing as complete the order of the symbols is as follows. reading from left to right:

- |                                 |                                  |
|---------------------------------|----------------------------------|
| 1. Diagonal Cross? (erased)     | 7. Diagonal Cross                |
| 2. <i>Venus (doubled form?)</i> | 8. <i>Venus and Death's head</i> |
| 3. <i>Venus and Peccary</i>     | 9. Diagonal Cross                |
| 4. Diagonal Cross               | 10. <i>Venus and Bird</i>        |
| 5. Moon in sky shield           | 11. Diagonal Cross               |
| 6. Imix in sky shield           | 12. Diagonal Cross               |

- |                               |                               |
|-------------------------------|-------------------------------|
| 13. Diagonal Cross            | 19. <i>Venus and Scorpion</i> |
| 14. <i>Venus</i>              | 20. Diagonal Cross            |
| 15. Diagonal Cross            | 21. <i>Venus and Vulture</i>  |
| 16. Diagonal Cross            | 22. Diagonal Cross            |
| 17. <i>Venus and Tortoise</i> | 23. <i>Venus and Reptile</i>  |
| 18. Diagonal Cross            | 24. Diagonal Cross            |

Now the series given in the Peresianus Codex in connection with the 364-day year may refer, as we have seen, to the continuous conjunctions of the sun with a series of star groups. It is gratifying to find that this series devoted to conjunctions of Venus shows a number of similar figures or symbols. Signs 17, 19, 21, and 23 of the Monjas series seem to be identical with signs 3 to 6 of the Peresianus series and to occur moreover in the same order. Other similar signs include the peccary, the death's head and a bird of uncertain genus (3, 8, and 10 of the Monjas series and 7, 12, and 13 of the Peresianus series). Certain stars in Gemini were called the Tortoise stars according to the Motul dictionary. In the opinion of the writer these two series of pictures furnish the best evidence so far presented that a sort of zodiac had been developed by the Indians of Central America. However, even this falls far short of absolute proof. It must be remembered that no certain calculations referring to sidereal time have yet been discovered in Mexico and Central America. The ritualistic year may have been chosen for the convenient factors of the number 364. It seems especially significant that while the Indians had observed that five synodical revolutions of Venus of 584 days require exactly as many days as eight solar years at 365 days, they do not seem to have discovered the additional fact that thirteen sidereal revolutions of Venus are completed at practically the same time. Förstemann has suggested that the sidereal revolution of Saturn may be recorded in one place but he is probably in error. As for Mercury, Mars, and Jupiter, it is possible that future studies will disclose a knowledge that at present is much in doubt. Observation of the many celestial bands on the ancient Maya monuments has failed to reveal any series of star symbols comparable to the two just presented. On the showing then of these two examples we may be justified in holding open the

question of the zodiac in America so far as the possibility of an independent invention in Central America is concerned. But surely the age-long fallacy of pre-Columbian introduction from Europe should be dismissed.

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